BP 4: Novel Methods

Time: Monday 14:30–16:00 Location: PC 203

BP 4.1 Mon 14:30 PC 203

A novel magneto-optical contrast mechanism in microscopy — •Gopalakrishnan Balasubramanian[1], Iu-Yam Chan[1], Roman Kolesov[1], Philip Hemmer[2], Fedor Jelezko[1], and Jörg Wrachtrup[1] — [1]3. Physikalisches Institut, Universität Stuttgart, 70550 Stuttgart — [2]Electrical Engineering, Texas A&M University, College Station, TX, USA

A novel non-contact optical imaging technique is presented that can achieve atomic scale resolution at standoff distances large enough to eventually permit molecular imaging at ambient conditions. The pioneering aspect of this technique is the use of single paramagnetic optically active centers in diamond as the probe. The feasibility of proposed scheme is based on recent key discoveries related to detection and manipulation of single Nitrogen-Vacancy (NV) centers in diamond. A spatially varying magnetic potential shifts the frequency of a ESR resonance of the probe system, so that the resonance frequency is position dependent. Proposed technique will enable nm resolution at long standoff distances.

BP 4.2 Mon 14:45 PC 203

SERS Microscopy: Selective and Sensitive Localization of Proteins in Tissue Specimens — •Magdalena Gellner[1], Max Schütz[1], Carina Jehn[1], Florian Baum[1], Bernd Küstner[1], Carsten Schmuck[2], Alexander Marx[3], Philipp Ströbel[3], and Sebastian Schlücker[1] — [1]Physikalische Chemie, Julius-Maximilians-Universität, 97074 Würzburg — [2]Organische Chemie, Julius-Maximilians-Universität, 97074 Würzburg — [3]Pathologisches Institut, Universitätsklinikum, 68167 Mannheim

We have introduced surface–enhanced Raman scattering microscopy (μSERS) as a novel approach to immunohistochemistry. Specifically, the localization of prostate–specific antigen (PSA) in formalin–fixed and paraffin–embedded prostate tissue specimens from patients undergoing prostatectomy for prostate cancer has been demonstrated. In contrast to the use of either dyes or fluorophores as labels, organic molecules as Raman markers on the surface of metal nanoparticles offer unique capabilities for a highly multiplexed detection, because the line width of vibrational transitions is significantly smaller in comparison to electronic transitions. The SERS distance dependence, the SERS selection rules and the specific electronic resonance conditions lead to the fact that only a very few Raman bands from the marker moiety close to the nanoparticle surface are detected. In our case the characteristic Raman signals of the marker were measured in the PSA–(+) epithelial tissue. For negative controls, Raman spectra in the PSA–(-) stroma and lumen were recorded. Further applications for this innovative Raman technique in cell and tumor biology are discussed.

BP 4.3 Mon 15:00 PC 203

Immobilization of semiconductor nanocrystals on nanopatterned interfaces — •Eva Bock[1], Stefan Kudera[1], Angela Fiore[2], Liberato Manna[2], and Joachim P. Spatz[1] — [1]Max-Planck-Institute for Metals Research, Dept. of New Materials & Biosystems & University of Heidelberg, Dept. of Biophysical Chemistry, Heisenbergstr. 3, D - 70569 Stuttgart — [2]National Nanotechnology Labs of CNR, Via Arnesano, I * 73100 Lecce

Here we describe different approaches for the functionalization of nanopatterned substrates with semiconductor nanocrystals which are exceptional materials for their unique optical flexibility. Gold nanoclusters with diameters between 2 and 30 nm and lateral distances of 20 to 250 nm are arranged onto silicon wafers with a uniform diameter and a defined interparticle spacing. The patterning technique is based on self-assembly of metal loaded diblockcopolymer micelles (polystyrene-b-poly[2-vinylpyridine(HAuCl4)]) which form a quasi-hexagonal closed packed monolayer. The individual gold nanoparticles are potential candidates for immobilizing single molecules or nanoscopic objects. Several approaches proved useful for the immobilization of different semiconductor nanocrystals, such as tetrapods, dimers and dumbbells. One method of assembling nanoparticles on the surface is based on thiol-chemistry, another one is based on the hybridization of DNA. A third approach involves the direct attachment of the nanocrystals on the gold dots without organic linker molecules.

BP 4.4 Mon 15:15 PC 203

Microscopical visualization of Gold-Nanoparticles for biological and medical applications — •Andrea Isabel Matschulat, Franz-Josef Schmitt, Max Schoengen, and Hans Joachim Eichler — Institut für Optik und Atomare Physik, Technische Universität Berlin, Strasse des 17.Juni 135, 10623 Berlin

The application of novel nanotechnologies, especially in biotechnology and nanomedicine looks very promising. Improved and partly new physical, chemical and biological properties of nanostructures make them to powerful tools in diagnostics and therapy. Gold-Nanoparticles in contact with living HCT-116 colon carcinoma cells were visualized with several microscopical techniques such as Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Scanning Near-Field Optical Microscopy (SNOM) and conventional Light Microscopy (LM). VIS-Spectroscopy was applied for studying long-time-stability and optical properties of the Gold-Nanoparticles. The goal is the *in vivo* visualization of the nanoparticles in living cells. This project is treated in collaboration with Surgical Research Unit OP 2000, Max-Delbrück-Centrum für Molekulare Medizin, Charité - Berlin *in vitro*. Especially in the field of conventional optical Far-Field Microscopy, measurements with colloids in living cells using a dark-field configuration showed that resolution was limited in the size range of 1 μm due to Abbe's limit of resolution and scattering effects, however, the particles were identifiable through their red colour as a result of the plasmon resonance effect which was calculated with classical Drude-Lorentz-model.

BP 4.5 Mon 15:30 PC 203

Combination of atomic force microscopy with timecorrelated fluorescence-spectrocopy — •Max Schoengen, Franz-Josef Schmitt, Andrea Matschulat, and Hans Joachim Eichler — Institut für Optik und Atomare Physik, Technische Universität Berlin

The combination of different microscopic techniques delivers completely new possibilities of analysing nanostructures. The topographic analysis performed with Atomic force microscopy can be complemented with time resolved fluorescence spectroscopy and fluorescence microscopy to deliver additional spectroscopic properties of the investigated sample with time and space resolution. With fluorescence microscopy even nanometer scaled structures can be visualised and localized inside the sample. Near field optical techniques like the combination of Foerster Resonance energy transfer (FRET) with AFM can help to investigate simultaneously the topographic and electronic properties of the nanoscaled structures (e.g. membrane proteins). Especially in liquids this kind of AFM combined with FRET technology opens complete new possibilities of analysing (biological) nanostructures like cell membranes.

BP 4.6 Mon 15:45 PC 203

Adressing cells via immobilized magnetite particles on magnetically variable substrates — •Juliane Issle and Uwe Hartmann — Universität des Saarlandes, Institut für Experimentalphysik, Campus C6 3, D-66123 Saarbrücken

It is well known that magnetite nanoparticles in the range of 200 nm are biocompatible and they are used in drug delivery, hyperthermia etc. A new approach of immobilizing these beads by means of magnetic interaction on certain substrates gives rise to the opportunity to adress cells via transmembrane pathways without particle internalization. Magnetometry and Magnetic Force Microscopy deliver insight to the structural and magnetic properties of the nanoparticles. Magnetic garnet layers with perpendicular anisotropy, which enables magnetic bead deposition, have been used. They turned out to be biocompatible and furthermore the domain structure can be varied by application of external magnetic fields. The calculation of the interaction between particles and surface stray field shows that the forces are in the 100 pN range, so that cells can not take up the beads once they are immobilized. A climate chamber and coils to produce magnetic fields were integrated into an inverted microscope. This allows the investigation of cell behavior over days with respect to structural substrate changes in the range of some seconds to several days.